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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/052,306	01/18/2002	Yumiko Kawano	2285/51302	8383

23911 7590 12/23/2003

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EXAMINER	
KIELIN, ERIK J	
ART UNIT	**PAPER NUMBER**
2813	

DATE MAILED: 12/23/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/052,306	KAWANO ET AL.	
	Examiner	Art Unit	
	Erik Kielin	2813	MW

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *22 September 2003*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-37* is/are pending in the application.

4a) Of the above claim(s) *5-11,13,16-25 and 32-37* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-4,12,14,15 and 26-31* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *18 January 2002* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. §§ 119 and 120

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

13)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application) since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

a) ☐ The translation of the foreign language provisional application has been received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121 since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 7.
4) ☐ Interview Summary (PTO-413) Paper No(s). _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Election/Restrictions

1. Applicant's election of the invention of Group I, species of Group A, with claims 1-4, 12, and 26-31 indicated to read thereon in Paper No. 14, filed 22 September 2003 is acknowledged. Because applicant did not distinctly and specifically point out the supposed errors in the restriction requirement, the election has been treated as an election without traverse (MPEP § 818.03(a)).

2. Claims 1, 2, 14, and 26-28 are generic to the elected species and will also be examined. Accordingly, **claims 1-4, 12, 14, 15, and 26-31 are active**.

3. Claims 17-25 and 35-37 are withdrawn from further consideration pursuant to 37 CFR 1.142(b) as being drawn to a nonelected invention, there being no allowable generic or linking claim.

4. Claims 5-11, 13, 16, and 32-34 are withdrawn from further consideration pursuant to 37 CFR 1.142(b) as being drawn to nonelected species, there being no allowable generic or linking claim.

Priority

5. Receipt is acknowledged of papers submitted under 35 U.S.C. 119(a)-(d), which papers have been placed of record in the file.

Claim Rejections - 35 USC § 112

6. The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

7. Claims 1, 14, 26-28 and 12, 29-31 are rejected under 35 U.S.C. 112, first paragraph, because the specification, while being enabling for tungsten or tungsten nitride, does not reasonably provide enablement for all metals and all metal compounds. The specification does not enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to use the invention commensurate in scope with these claims.

8. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

9. Claims 14, 15, 28 and 31 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Regarding claims 14 and 15, as presently written, it is unclear if "the film forming step" or "the time during which preparation process step is performed" controls "the shape of the bump." This must be made clear. The claims will be interpreted as best understood by Examiner.

Regarding claims 28 and 31, the phrase "the method forms capacitance" is unclear. Examiner assumes that the method is for forming a capacitor.

Claim Rejections - 35 USC § 102

10. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

11. Claims **1**, 27 and **12**, 30 are rejected under 35 U.S.C. 102(b) as being anticipated by **Wolf**, Silicon Processing for the VLSI Era, Vol. 2-Process Integration, Lattice Press: Sunset Beach CA, 1990, pp. 245-252.

Regarding claim 1, **Wolf** discloses a method of manufacturing a semiconductor device comprising:

a preparation process step of supplying a substance (specifically Ar and WF_6) for restricting formation of nuclei for growing a metal film or a metal compound film onto a surface of a process target substrate; and

a film forming step of forming a metal film or a metal compound film whose surface has bumps on said substrate by supplying a material of said metal film (specifically H_2 and WF_6) or said metal compound film onto the surface of said substrate after said preparation process step.

Regarding claim 12, **Wolf** discloses a a method of manufacturing a semiconductor device comprising:

a preparation process step of supplying a halogen element (specifically Ar and WF_6) onto a surface of a substrate; and

a film forming step of forming a metal film or a metal compound film whose surface has bumps on said substrate by supplying a material of said metal film (specifically H_2 and WF_6) or said metal compound film onto the surface of said substrate after said preparation process step.

(See Wolf, p. 246, last paragraph and Figs. 4-40 and 4-42. More particularly, compare the last paragraph on p. 246 with Applicant's Fig. 2 which shows that Ar and WF_6 is the preparation step gas while WF_6 is also the gas to form the WN_X film.)

Regarding claims 27 and 30, **Wolf** discloses that

said preparation process step is a step of supplying the substance (specifically Ar and WF_6) for restricting formation of nuclei onto the surface of said substrate that has predetermined roughness; and

said film forming step is a step of forming on said substrate, a metal film or a metal compound film which has bumps that are rougher than the surface of said substrate (Figs. 4-40 and 4-42).

12. Claims **1**-4, 26, 27, and **12**, 29, 30 are rejected under 35 U.S.C. 102(e) as being anticipated by US 6,087,257 (**Park** et al.).

Regarding claims 1 and 12, **Park** discloses a method of manufacturing a semiconductor device comprising:

a preparation process step of supplying a halogen element (specifically WF_6) onto a surface of a substrate; and

a film forming step of forming a metal film or a metal compound film (specifically WN_X) whose surface has bumps on said substrate by supplying a material of said metal film or said metal compound film (specifically H_2, NH_3, and WF_6) onto the surface of said substrate after said preparation process step (Figs. 4A-4D; col. 6, line 51 to col. 7, line 15).

Regarding claims 2, 3, and 4, the said preparation process step comprises a step of supplying a substance which inherently restricts adhesion of NH_3 onto the surface of said substrate; and

said film forming step comprises a step of forming a tungsten nitride film whose surface has bumps on said substrate by supplying WF_6 and NH_3 onto the surface of said substrate (See Fig. 4D).

The restriction of the adhesion of NH_3 by the halogen-containing WF_6 is seen to be inherent by admission of Applicant in the instant specification (instant Fig. 3, for example) and, additionally, is implicitly taught in Park with reference to Figs. 4A-4D. At higher ratios of NH_3 to WF_6, the WF_6 is shown to be less effective in preventing nucleation (Fig. 4D). At lower ratios, on the other hand, deposition is nearly selective to the contact opening (Fig. 4B and 4C) because sufficient WF_6 can reach the surface around the contact opening to prevent NH_3 adsorption. (See MPEP 2112 regarding inherency.)

Regarding claims 26 and 29, said preparation process step is a step of supplying the substance for restricting formation of nuclei onto the surface of said substrate that is substantially plane; and said film forming step is a step of forming a metal film or a metal compound film which has bumps on said substrate (Figs. 4C-4D).

Regarding claims 27 and 30, said preparation process step is a step of supplying the substance for restricting formation of nuclei onto the surface of said substrate that has predetermined roughness; and said film forming step is a step of forming on said substrate, a metal film or a metal compound film which has bumps that are rougher than the surface of said substrate (Figs. 4C-4D).

13. Claims 1, 14 26, 27 and 12, 15, 29, 30 are rejected under 35 U.S.C. 102(b) as being anticipated by US 5,633,201 **(Choi)**.

Regarding claim 1, **Choi** discloses a method of manufacturing a semiconductor device comprising:

a preparation process step of supplying a substance for restricting formation of nuclei (BCl_3, Cl_2 and HF) for growing a metal film or a metal compound film onto a surface of a process target substrate; and

a film forming step of forming a metal film or a metal compound film whose surface has bumps on said substrate by supplying a material of said metal film or said metal compound film onto the surface of said substrate after said preparation process step.

Regarding claims 14 and 15 the time that the preparation process is controlled for example at 30 seconds; therefore, the shape of the bumps at the surface of the tungsten metal plug **8A** is dictated by this time (paragraph bridging cols. 3-4).

Regarding claims 26 and 29, said preparation process step is a step of supplying the substance for restricting formation of nuclei (BCl_3, Cl_2 and HF) onto the surface of said substrate that is substantially plane; and said film forming step is a step of forming a metal film or a metal compound film which has bumps on said substrate.

Regarding claims 27 and 30, said preparation process step is a step of supplying the substance for restricting formation of nuclei (BCl_3, Cl_2 and HF) onto the surface of said substrate that has predetermined roughness; and said film forming step is a step of forming on said

substrate, a metal film or a metal compound film which has bumps that are rougher than the surface of said substrate.

(See Choi Abstract and Figs. 2A-2B and paragraph bridging cols. 3-4.)

14. Claims 1, 14, 29 and 12, 15, 31 are rejected under 35 U.S.C. 102(b) as being anticipated by US 5,563,090 (**Lee** et al.).

Regarding claim 1, **Lee** discloses a method of manufacturing a semiconductor device comprising:

a preparation process step of supplying a substance for restricting formation of nuclei (specifically TiN; col. 4, lines 25-41) for growing a metal film 7 (tungsten) or a metal compound film onto a surface of a process target substrate (Figs. 1 and 2d); and

a film forming step of forming a metal film (tungsten) or a metal compound film whose surface has bumps (Figs. 1 and 2d) on said substrate by supplying a material of said metal film or said metal compound film onto the surface of said substrate after said preparation process step.

Regarding claims 14 and 15, the film formation time controls the shape of the bumps as disclosed at col. 4, lines 34-53) to be at 50 to 150 nm.

Regarding claims 28 and 31, the method of claims 1 and 12, respectively, further comprising

a step of forming a conductive film **9** which faces said metal film (tungsten) or said metal compound film via an insulation material **8**, wherein said "method" forms capacitance (Fig. 2e).

15. Claims **1**, 14, 26, 27, and **12**, 15, 29 30 are rejected under 35 U.S.C. 102(b) as being clearly anticipated by EP 0 349 695 (**Hirase**), the reference provided by Applicant in the IDS filed 4 October 2002.

Hirase discloses pretreating a silicon substrate with a halogen-containing gas (N_2F_4, ClF_3, ClF_5, F_2, Cl_2, and CF_4; Abstract) for a controlled period of time to control nucleation and therefore the surface morphology (i.e. bumps) in the deposited tungsten metal film (Figs. 1A-1C; cols. 1-3).

Conclusion

16. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

US 5,502,005 (**Mikagi**, **109** in Fig. 4D) and US 5,622,888 (**Sekine** et al.**73a** and **73b** in Fig. 3(b)) each teach forming roughened tungsten surfaces. **Sekine** additionally teaches that the tungsten is an electrode in a capacitor.

US 4,552,783 (**Stoll** et al.) teaches that chlorine and bromine treatment of an insulator surface prevents nucleation of tungsten on the insulator surface, allowing selective deposition (Abstract).

US 4,913,929 (**Moslehi** et al.) teaches that surface morphology of tungsten nitride films is controlled by deposition conditions (col. 6, lines 53-68).

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Erik Kielin whose telephone number is 703-306-5980. The examiner can normally be reached on 9:00 - 19:30 on Monday through Thursday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead, Jr., can be reached at 703-308-4940. The fax phone numbers for the organization where this application or proceeding is assigned are 703-872-9318 for regular communications and 703-872-9319 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.

Erik Kielin
Primary Examiner
December 15, 2003